Reliance
Industries Limited
Growth is Life

**Recron 3S  Synthetic Fiber Secondary Reinforcement**
Making A Stronger World

Secondary Reinforcement Synthetic Fibers for Concrete , Shotcrete & Mortars

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# Recron 3S Synthetic Fiber Secondary Reinforcement

**Recron 3S** is an secondary reinforcement product for construction developed in house by Reliance Industries Limited at State of Art R&D facility at Patalganga. Representing a quantum technological leap in fibers for concrete, our high performance fibers are made from revolutionary modified polyester, which has been especially designed to form an internal support system for concrete when it needs the most. The uniqueness of Recron 3S fiber is its triangular shape, which give better anchoring with concrete, which is not found in most of the fibers available worldwide.

Concrete is widely recognized as a cost-effective, versatile construction material. Yet it is also beset with a number of drawbacks that are inherent to its composition. By generally accepted engineering standards, concrete is relatively brittle and lacks flexural strength. Intertwined with these problems is concrete's propensity to crack in both its plastic (early-age) and hardened (long-term) state. Early-age cracks are microscopic fissures caused by the intrinsic stresses created when the concrete settles and shrinks over the first 24 hours after being placed. Long-term cracking is in part caused by the shrinkage that transpires over the months, perhaps years, of drying that follow. In either case, these cracks can jeopardize the overall integrity of the concrete and not allow it to maintain – or possibly ever attain – its maximum performance capability. **Recron3S Fiber Reinforcement Systems can provide a solution to most of these problems.**

**Integral Benefits of Recron3S Fibers Embedded in Concrete are:**

- ***Reduction in Intrinsic Plastic & Drying Shrinkage Cracking:*** The tendency of the concrete has been accepted as its natural characteristic. Cracks occur in concrete when stress within the concrete exceeds the strength of the concrete at that specific time. Providing higher structural strength to the concrete can cater to stress from the external forces. However, intrinsic stresses caused by shrinkage, with in the concrete itself have been a problem due to their unprecedented variety and occurrence.

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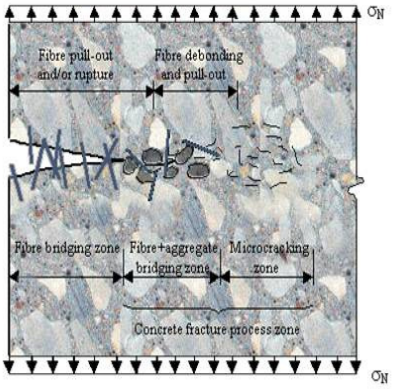


Fibers act as an internal support system, facilitating the retention of a homogenous concrete mix. Fibers randomly oriented in the concrete matrix provide a unique bridging mechanism by virtue of which intrinsic cracks formed are intercepted and bridges by the fiber right at the micro level. Higher probability of Fiber-Crack encounters contributes to the development of concrete's optimum long-term integrity throughout its life. Fiber parameters which govern the crack control and failure inhibition action include:

- High Fiber Area
- High Bond Strength
- Balanced Fiber Pull-Out & Rupture Strengths
- High Fiber Aspect Ration (L/D)

Fibers not only retards crack initiation but also reduces the crack width expansion caused by long term thermal gradient exposures & induced stress due to dynamic & static loading on the structure. It has been found that in view of the bridging mechanism induced by presence of Recron3S fiber the crack width widening & subsequently permeability of the structure is retarded drastically.

ACI Building Code [4] (Section 10.6.4) 1995, recommends a maximum crack width of 400 μm and 330 μm for interior and exterior exposure conditions, respectively for a durable concrete. The durability correlation as specified by ACI states that

Durability □ Permeability □ (Crack Width) $^3$

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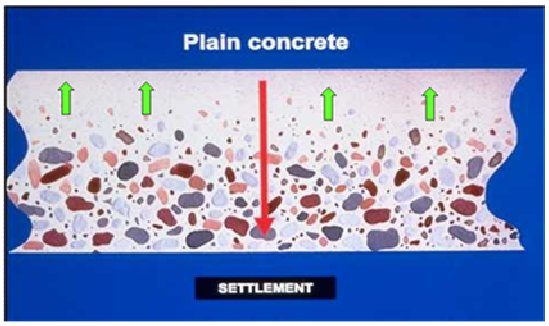
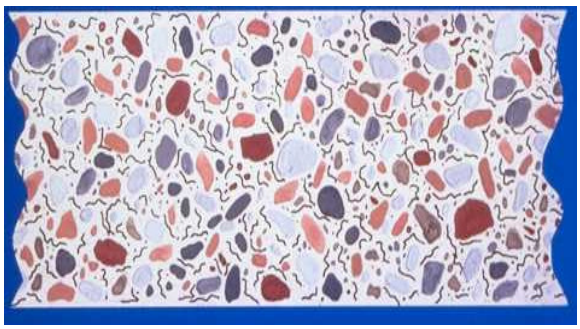
*Regardless of the ultimate tensile strain, average crack width remains at 60 µm in*

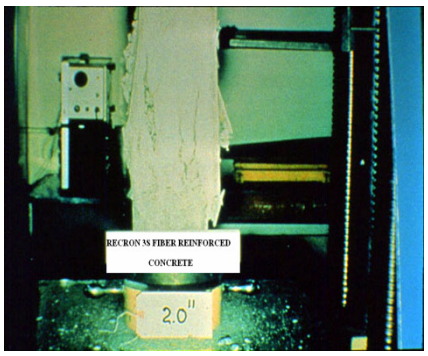


*Fiber Reinforced Concrete.*

- ***CONTROLS PLASTIC SETTLEMENT***

  Fibers also act as an internal support system retaining a more homogeneous concrete mix. Fibers discourage the natural segregation and settlement of concrete ingredients. The internal support system provided by the fiber results in a more uniform bleeding because the mix water is not displaced and rapidly forced to the surface by downward movement of concrete ingredients.




- ***IMPROVES THE POST PEAK DUCTILITY OF CONCRETE*** Conventional Concrete under application of continuous loading is found to undergo brittle failure. FRC on the other hand exhibits better ductile characteristics & is found to sustain more load after peak before brittle failure.

- ***INCREASES WET & DRY ABRASION RESISTANCE***

  Abrasion is resisted when the surface of concrete has uniform quality paste. Recron 3S fibers contribute to the development of this quality paste by contribution of

plastic settlement and plastic shrinkage crack control. Fiber reinforced concrete pavements can sustain greater wear and continual pounding than non-fiber reinforced concrete pavements, extending their service life.

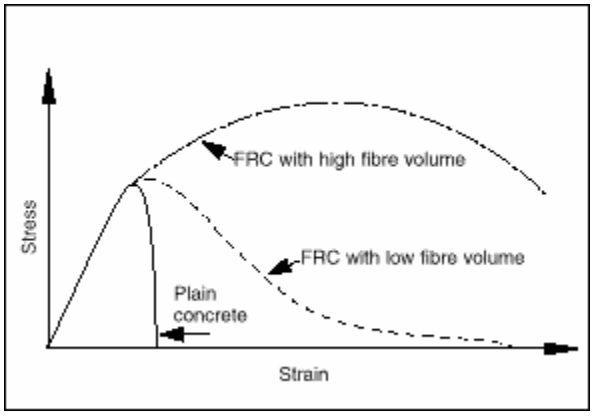
- ***INCREASES IMPACT / SHATTER RESISTANCE***

RECRON3S fiber reinforcement reduces the total crack void structure, which enables concrete greater shock absorbing quality by transforming it from more brittle to more ductile material.

- ***REDUCES WATER PERCOLATION & CONCRETE PERMEABILITY***

Permeability of concrete is lowered by reduction of plastic crack formation which further reduces water percolation.

- **INCREASES TOUGHNESS OF HARDENED CONCRETE**

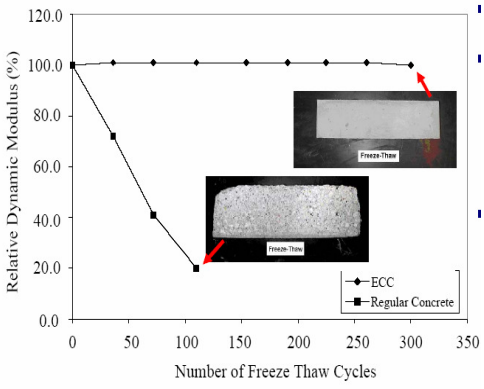



The first-crack strength characterizes the behavior of the fiber-reinforced concrete up to the onset of cracking in the matrix. While the toughness indices characterize the toughness thereafter up to specified end-point deflections. Residual strength factors, which are derived directly from toughness indices, characterize the level of strength retained after first crack simply by expressing the average post-crack load over a specific deflection interval as a percentage of the load at first crack. The importance of each depends on the nature of the proposed application and the level of serviceability required in terms of cracking and deflection. When a propagating crack front encounters a polymer fiber array, the homogenous growth will be disrupted as the front penetrates between the fibers, and additional fracture work is

required to overcome the barrier effect as the penetration depth increases, the bridging force rises rapidly and eventually the fibers will fail, either through fiber pull-out or breakage. Due to the decrease in fracture resistance, the crack front will jump forward until the crack growth driving force is reduced to the critical value to arrest the advancing crack. During this process, a certain amount of the strain energy stored in the sample is dissipated because of the increase in fracture surface area and the failure of fibers.

- **REDUCES DAMAGING EFFECTS DUE TO FREEZE THAW CYCLES**

Fiber imparts to the concrete much needed modulus of elasticity during the freeze thaw cycles and hence mitigating the damages. When exposed to freezing and thawing action, the durability of concrete is found to decrease concomitant with losses in its strength but its toughness is affected by the presence of fibers. A high content of long fibers produces a toughness-retaining effect.




- **RECRON 3S FIBERS REDUCES REBOUND LOSS BY UP TO 50-70% IN SHOTCRETE**

Fibers improves the inter particle cohesion on account of enhanced surface area (on account of fiber length & dimension. This cohesion reduces heterogeneity of concrete mix thus promotes the concrete fluidity & rheology hence the user gains on account of enhanced adhesion & lesser rebound loss of shotcrete mix.

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- **RECRON 3S FIBERS IMPROVE THE LONG TERM DURABILITY OF CONCRETE**

  Long term durability of concrete is enhanced with the use of quality mix designs workmanship & fiber reinforcement. The unique advantage with fiber reinforcement of reduced shrinkage cracks, plastic settlement, uniform bleeding, reduced plastic crack formation, increased abrasion resistance, reduced water migration added toughness and post crack residual strength synergistically combine to allow the concrete to develop its optimum long term durability & integrity.

- **CAN REPLACE NON-STRUCTURAL WIRE MESH**

  Steel fabric only functions after the concrete has cracked. Its function being to slow down the propagation of the shrinkage cracks from the surface into the slab. Fibers prevent the initiation of the cracks at an early age and thus entirely prevent the problem of crack propagation and fracture from arising.

- **IMPROVES FLEXURAL FATIGUE RESISTANCE**

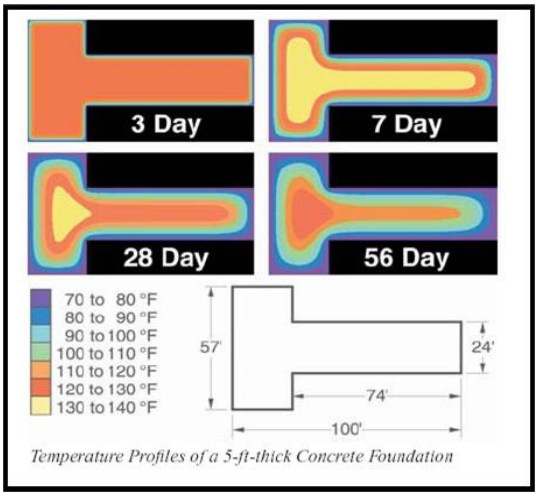
  One of the important attributes of FRC is the enhancement of fatigue strength compared to plain concrete. Failure strength is defined as the maximum flexural fatigue stress at which the beam can withstand two million cycles of non-reversed fatigue loading. In many applications, particularly in pavements and bridge deck overlays, full depth pavements and industrial floors, and offshore structures, flexural fatigue strength and endurance limit are important design parameters mainly because these structures are subjected to fatigue load cycles. The endurance limit of concrete is defined as the flexural fatigue stress at which the beam could withstand two million cycles of non-reversed fatigue loading, expressed as a percentage of the modulus of rupture of plain concrete. Strength using the same basic mixture

proportions, the flexural fatigue strength when determined with fibers shows that the endurance limit for two million cycles had increases by 15 to 18 percent.

- **BETTER STRESS TRANSFER AT JOINTS**

  High tensile strength fibers create a tighter aggregate interlock at cracks and contraction joints, which increases load carrying capacity and provides more stable stress transfer.

- **MASS CONCRETE : RECRON 3S CAN IMPROVE HEIGHT PER LIFT**



*Temperature Profiles of a 5-ft-thick Concrete Foundation*

Enormous amount of Heat of Hydration released during initial hours of poring of the concrete cause's differential shrinkage hence, forces to have low lifts per batch hence increases the no of joints. This significantly affects the pace of work due to stipulated gaps required between two lifts. Fibers are proven to provide concrete the much required tensile strength during the critical initial setting phase, this phenomenon is of vital importance in Mass Concrete. Fiber can reduce the damaging effects of thermal stress caused during this period & thereby provide chances of exploring possibility of enhancing the lift height per pour, which will result in lesser no of joints & faster pace of work.

# Recron 3S Synthetic Fiber Secondary Reinforcement

## RECRON 3S MICRO FIBER APPLICATION WISE BENEFIT CHART

| | | |
|---|---|---|
| ***Plain Cement Concrete (CC Roads, Industrial Floorings, Concrete linings, Rigid Pavements)*** | ♦ Strict Crack Control<br>♦ Reduced Abrasion Resistance<br>♦ Double Impact & Shatter Resistance<br>♦ Improved Energy Absorption<br>♦ Reduces top to bottom & vis-à-vis water penetration<br>♦ Improved Flexural Strength.<br>♦ Improved Fatigue Resistance. | ♦ Can replace Secondary / Temp steel.<br>♦ Thickness can be economized at elevated dosages.<br>♦ Reduced maintenance cost on long term perspective. |
| ***Reinforced Cement Concrete (RCC- Structural Concrete, Bridges, Deck Slabs, PSC etc.)*** | ♦ Strict Crack Control<br>♦ Double Impact & Shatter Resistance<br>♦ Improved Energy Absorption.<br>♦ Reduction in Surface water absorption.<br>♦ Resists corrosion of steel.<br>♦ Improves Ductility under cyclic loading | ♦ Reduces life cycle maintenance cost.<br>♦ Enhanced life of the structure. |

| | | |
|---|---|---|
| | (Seismic)<br>♦ Reduced segregation & bleeding of concrete | |
| ***Mass Concrete (Bridge Pears, Dam Concrete, Spillways & Barrages)*** | ♦ Strict Crack Control<br>♦ Better Thermal Stress resistance.<br>♦ Improved toughness by upto 100%<br>♦ ***Other benefits equivalent to RCC*** | ♦ Can reduce pour height per lift.<br>♦ Reduced no of joints per unit length.<br>♦ Reduced Cavitations damages. |
| ***Shotcrete*** | ♦ Gives more cohesive & homogenous mix.<br>♦ Reduces Shotcrete spalling.<br>♦ Enhances adhesion | ♦ Reduces rebound by up to 60%<br>♦ Can replace WWF at higher dosages.<br>♦ Reduces equipment wear & tear.<br>♦ Improves thickness per pass. |

# Recron 3S Synthetic Fiber Secondary Reinforcement

## RECRON 3S VARIANTS

## PRICE LIST, SPECIFICATION & NOMENCLATURE

| S No. | Merge | Specification | Application | Packing Unit | Price Per Unit |
|---|---|---|---|---|---|
| 1. | CT-2024 | 12mm Polyester Triangular Fiber for all type of Concretes | RCC, PCC, PQC, Str Concrete | 125gms for Site Mixer | Rs.47.00 |
| 2. | CT-2424 | 12mm Polyester Triangular Fiber for all type of Concretes | RCC, PCC, PQC, Str Concrete | 900gms for Batching Plant | Rs.340.00 |
| 3. | CT-2012 | 06mm Polyester Triangular Fiber for Concrete Mortars & Plasters | Thin Section concrete, mortars & plasters | 125gms for Site mixer & manual mixing | Rs.47.00 |
| 4. | CT-2436 | 18mm Polyester Triangular Fiber for High Performance Concrete & Shotcrete | High Performance Concrete Pavements & Shotcrete | 1200gms for Batching Plants | Rs.451.00 |

## Nomenclature for Specification in Tenders & BOQ's

### Concrete

Polyester Triangular Fiber (Recron 3S make) of 12 / 18 mm length, 30-35 micron Diameter with a melting point 240-260 °C shall be homogenously mixed with concrete @ 0.25 % of the weight of cement (as specified in design mix) or as specified by the manufacturer.

### Plaster

Polyester Triangular Fiber (Recron 3S make) of 6 mm length, 30-35 micron Diameter with a melting point 240-260 °C shall be homogenously mixed with mortar @ 0.25 % of the weight of cement (as specified in design mix) or as specified by the manufacturer.